

3D Technology in E-tail: A Synthesis through Literature Review

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Abstract: As online shopping continues to gain popularity, retailers are finding new ways to enhance the customer experience. One of the latest innovations is the use of 3D technology to showcase products. This study is based on secondary data, different studies done earlier were reviewed and explored the changes came in online retail because of 3D technology. Theories related with technology describe the different factors which are responsible for the adoption of new technology in online retail environment. The objective of this study is to shed light on use of different facets of 3D technology in virtual retailing differently. Researchers observed that now a days, 3D is used with other metaverse technologies i.e. augmented reality and virtual reality to enhance customer experiences. This study might provide a good conceptual ground to marketers, online retailers and technology developers to get the best practical implication of this new emerging technology in this era of digitalization.

1. Introduction

In the coming years, the scope of e-commerce will get a boom in the Asian region and India is the fastest-growing e-commerce market in this region, which means there will be huge scope for e-commerce in India. Internet users are expected to increase over 1.48 billion in 2030 and 1.6 billion in 2050 (Basuroy, 2023). The Indian e-commerce sector is projected to reach USD 200 billion by 2026, USD 350 billion by 2030 (ibef, 2023). “The backbone of any good business model for the retail industry should address four catalysts that drive disruption: economy, enabling technology, platforms and consumer mindset” (Deloitte, 2017). Now a day many e-tailers are adopting new ways to lure customers that results in their engrossing in the digital world because of more interactivity and vividness. Some other e-tailers like amazon, flipkart and pepperfry are adopting 3D view technology to attract more and more customers.

Visual presentation of products in e-platform influences the decision making of consumers because visual senses play a major role in e-tailing. In today's era, wily e-commerce dealers provide product presentations in such a way that consumers can see it from all angles, zoom in and see videos (Choi and Taylor, 2014). Product presentation affects mental imagery in the online environment (Yoo and Kim, 2014). Mental imagery described as a process of representation of non-verbal information (Gavilan *et al.*, 2014), stimulation in the customer's imagination (Ha *et al.*, 2019). Mental imagery is the process of representation of "sensory or perceptual experience" in human mind in terms of "ideas, feelings and memories" (Yoo and Kim, 2014). It consists of three basic dimensions which are "vividness, quantity and elaboration" (Gavilan *et al.*, 2014), two dimensions "quality and elaboration" (Ha *et al.*, 2019; Yoo & Kim, 2014). Rathee and Kumari (2022) revealed that virtual try-on technology of product presentation positively influences all the three dimensions of mental imagery namely "vividness, elaboration and quantity".

Liberman and Trope (1998) proposed construal level theory, according to which there are two categories of mental representation: concrete and abstract. Concrete mental representation focuses on the subordinate nature of products like "attributes, smells, tactile and color". On the other hand, abstract mental representation's focus is on super-ordinate nature like "price and overall impression" (Liu *et al.*, 2017). Concrete pictures provide greater elaboration that affects mental imagery which facilitates more product experience in the virtual environment (Yoo and Kim, 2014). Mental imagery act as a mediator between "type of ad and ad trust" and have a significant impact on purchase intention (Gavilan *et al.*, 2014), a positive attitude through positive affect (Ha *et al.*, 2019). It makes one able to get the same experience as they get in the real world while touching the products. Stimulus of mental imagery is the most important when one cannot touch products. More product image on an online platform leads to perceptual-reenactment that stimulates customer's senses and helps to fill missing features of products (Spence and Deroy, 2013) like olfactory and gustatory and desire to touch it.

3D advertising gives a more favorable result for geometric products. It can be partially good for material products because 3D advertising creates more vividness in mental imagery that results in "tactile illusion" which satisfies the need for touch and "develop concrete mental model" which stimulates experience like a product is in the real world. As per the Transportation Imagery Model, 3D experiences result "more vivid and realistic product imagery and more favorable attitude" (Choi and Taylor, 2014). E-tailers are turning toward 3D product presentations to get a competitive advantage and provide more sensory experiences to customers. The Internet is just a channel that helps in advertisement, distribution and marketing, but its efficiency is increased if there is more interactivity and good multimedia presentation (Edwards & Gangadharbatla, 2001). While utilising 3D technology during the goods display instead of 2D technology, customer engagement rises by 66% (Melnyk, 2019). Even though, there is scarcity of studies in the context of 3 dimensional technologies, even if it provides lots of benefits. Ambika *et al.* (2023) mentioned that as compared to virtual reality (VR) 39% and augmented reality (AR) 37% studies, only 12% studies were conducted on 3D product presentation.

The objective of this study is to synthesize the available literature of 3D technology and contribute in online and sensory marketing literature by providing the deep insight about customer behavior in

technological era. The outcome of this study may be helpful for technology developers as well as retailers in understanding consumer behavior and their needs in current scenario.

2. Conceptual Background

2.1. 3D

Raed S. Algharabat and ElSamen (2013) defined “3D product presentation” as a “psychological state in which virtual objects presented in 3D are perceived by consumers as actual objects, which convey to customers relevant product information that helps them in understanding and evaluating the quality and performance of products sold online.” 3D images have higher persuading power than 2D images (Choi and Taylor, 2014).

3D product presentation quality is a multidimensional construct. Website quality and 3D product presentation quality affect the consumer’s perception. “E-shopping quality refers to the overall consumer perception of the excellence and effectiveness of an e-tailer’s product and/or service offering through its virtual store.” Website features, quality and performance influence the perception of consumers toward e-shopping. Product presentation in 3D technology affects the psychological as well as the emotional state of users that creates a good virtual product experience (VPE). Customers’ ability to feel, touch and to try product increases if 3D has high product presentation quality. 3D also increases attitude, purchase intention and knowledge of consumers. The level of interactivity and vividness enhance telepresence, which affects the quality of 3D (Algharabat *et al.*, 2017). 3D virtual model increases the consumers “telepresence and image interactivity” that provide more information regarding “touch and feel or fit” (In Shim & Lee, 2011).

The technology of VPE is divided into two types: “visual control and functional control”. Visual control means “software which allows consumers to move, rotate and zoom in and out a product’s image, see it from different angles, distances and perspectives”. Functional control means “software which enables consumers to simplify different functions of products through their computers”. Antecedents like “information quality, system quality, authenticity and enjoyment” affect the quality of 3D. 3D-Q has a significant influence on both “attitude toward website and attitude toward presented product”. These attitudes have a significant influence on the users’ satisfaction which is moderated by the VPE (Algharabat *et al.*, 2017). Internet shopping trust is a moderating variable to reduce the perceived risk, because shopping experience increases the level of trust among customers which further influence risk perception. Consumer’s model can be generated by them in 3D virtual model by their body size and they can get the fit related information. So their actual body size work as a moderating variable and helps to reduce risk (In Shim & Lee, 2011).

The novelty of 3D product has positive outcomes; it enhances “sense of enjoyment” that leads to “loss of self-consciousness”. The product presented in 3D provides more indirect experience than traditional media does. Novelty of 3D can process information in such a way that distract one’s attention from the internal state and increase focus on the environmental stimuli, which leads to more information processing. Curiosity and more information seeking is the behavior of customers. 3D presentation with information has a significant effect on attitude toward the website (Edwards & Gangadharbatla, 2001).

3D presentation enhances “sense of enjoyment” and online experience by increasing interactivity (Edwards & Gangadharbatla, 2001). 3D emerges as a new technology for presentation of product which enables customers to see the shape and surface of a product so they can imagine it. Interactivity enhances vivid mental images of different sensory modalities “taste, touch and smell” and vividness leads to mental stimulation that helps to increase purchase intention. According to different studies 3D interactivity positively influences brand attitude, product knowledge, purchase intention and revisit intention by zooming and rotating product in any direction and provide more vivid mental imagery (Choi and Taylor, 2014). In comparison to the three-dimensional virtual reality condition, respondents’ purchase intentions were higher in a three-dimensional web condition (Kang *et al.*, 2020).

2.2. Theoretical Support in Technology Acceptance

The technological acceptance model describes the different factors which are responsible for the adoption of new technology in online retail environment. The adoption theory aims to explain different important factors that push peoples to make a specific behavior. Fishbein and Ajzen (1975) developed the first model of adoption theory that is “theory of reasoned action (TRA)”. According to this model, the intention is determined by attitude and subjective norms attached to the behavior. Intention works as a predictor that predicts shoppers’ behavior. The theory of planned behavior is another model proposed by Ajzen in 1991. In this model, a new construct is added in TRA that is “perceived behavioral control”. According to this model “Individuals’ perception of control, attitude toward behavior and subjective norm” influence the intention that leads to a particular behavior (Dang and Pham, 2018). While purchasing goods online customers’ purchase intention was higher in case of higher “perceived behavior control” as compared to low level of “behavioural control” (Abdul and Soundararajan, 2022). Gupta (2021) stated that “perceived behavior control” is a strong predictor of green purchase intention among youth towards green product. Different researchers use this model to study the acceptance of individuals and use of different information technologies like advertising, shopping and mobile services (Ghazali *et al.*, 2018).

In 1989 Davis proposed another model, TAM (Technology Acceptance Model). This model depicts that to adopt a particular technology; individuals’ intention is determined by belief. Belief included two variables named “perceived ease of use and perceived usefulness”. Perceived ease of use means “the degree to which an individual believes that using a particular system would be free of physical and mental effort” (Davis, 1989). Perceived usefulness means “the degree to which an individuals’ believes that using a particular system would enhance his or her job performance” (Davis, 1989). Acceptance or rejection of technology depends upon the enhancement of people performance by technology, not by the effort increasing to perform that function (Dang and Pham, 2018).

Different customers have different views regarding the acceptance and non-acceptance of technological development. As the new product visualization technology emerges, retailers’ adoption of technology is not as important as customers’ adoption and usage of new innovative technologies. Traditionally TAM is a tool to examine the disparity “between the technological innovations which both consumers and organisations are expected to use and those that they will accept and use”. PEOU (perceived ease of use) and PU (perceived usefulness) are the key factors. PU enhances customers’

activities and PEOU means easiness in using a system. Individual differences, attitude and characteristics are external variables that influence PU and PEOU (Bonetti *et al.*, 2018).

In another study, different factors are studied which influence customer's intention, because a mobile shopping has many advantages. Despite this use of m-shopping was low in Malaysia. The researcher "integrate TAM and TPB (theory of planned behaviour) with PI (purchase intention) and trust in a framework" to study the intentions of Malaysian shopper to adopt mobile shopping. In a different study various constructs were added in TAM and TPB "compatibility, convenient, connectivity, perceived enjoyment, facilitating conditions, perceived risk and trust" to explore the behavioural intention of consumers (Ghazali *et al.*, 2018).

To predict customer behavior in different IT systems, TAM is extended with the construct of TPB by Ajzen in 1985. To study customer's intention, this model is appropriate which studies M-shopping that is closely related to "mobile commerce and payment". In another study Kim and Lee studied "the effect of innovativeness on PEOU but not the direct effect on intention" (Ghazali *et al.*, 2018). Researchers concluded that when technology is "user-friendly, easy to use and free from mental effort, "increase in adoption tendencies. A different study in Vietnam, adoption theory and TAM is used to study the influence of different factors namely "web design, reliability, privacy and customer" on purchase intention (Dang and Pham, 2018).

Ambika *et al.* (2023) included the top theories adopted in 3D technology studies were "flow theory, social presence theory and theory of telepresence" means that 3D evokes more illusionary sense, that provides a better viewpoint on what is displayed in demonstrations and videos for products (Ambika *et al.*, 2023). Other theories like situated cognition, technology adoption model (TAM), stimulus-organism-response (SOR) were widely used in AR research and Flow theory, telepresence theory, stimulus-organism-response (SOR) theory, theory of technological mediation were in VR studies (Ambika *et al.*, 2023).

3. Methodology

This study describes a theoretical review-based work written using the body of existing literature as a basis for the review. Articles from academic journals, research papers, and websites served as the foundation for this study. The existing body of literature aided in comprehending the idea of 3D and exploring the changes that came in online retail because of 3D technology. The current study began with a short overview, highlighted the dearth of previous studies on 3D technology and outlined the objectives of the study. The literature from multiple databases, including Elsevier, Web of Science, Proquest, Scopus, Emerald, Sage, and Google Scholar was searched using keywords associated with 3D technology in online retail.

4. Review of Literature

Idrees *et al.* (2023) done a systematic review on 3D body scanning mobile apps. They stated it as a metaverse technology that can provide many advantages to "fashion retailers and fashion buyers" like "capturing individual body data", "personalize size recommendation", "virtual try on", "sustainability" and "low return rates". So the buyers can get right information regarding size and fit of the apparel. Hence, the customers become more confident while buying fashion product.

Ruusunen *et al.* (2023) had a study on 360 virtual store shopping. They examined that whether 360 virtual stores can fill the gap of need to touch a product. They stated that customers' sense of presence in a 360 virtual store leads to positive attitude towards online shopping and their need to touch the utilitarian items may be compensated.

Kang *et al.* (2020) conducted a study on 3D virtual reality store in online marketing. They included three features namely "interactivity, visual- spatial cues and graphic quality". They found that the interactivity and visual spatial cues increase the enjoyment and perceived information. In comparison to traditional shopping environment, 3D provides more information and enjoyment. When consumers' experience enjoyment, they give preference to visual cues. But their purchase intention is most influenced by the information provided to them (Kang *et al.*, 2020).

Algharabat *et al.* (2017) discussed on the multidimensional construct of 3D-Q and found the effect of 3D-Q on "attitude toward presented product and attitude toward website." Virtual product experience works as a moderator between "attitude toward the presented product, attitude toward website and satisfaction." This study was conducted with the help of a hypothetical website in which 3D laptop is presented and the user could control the form and contents. They stated that 3D-Q is depend on its antecedents and it is a multidimensional construct namely "information quality, system quality, authenticity and enjoyment". They found that authenticity has more influence than other constructs of 3D-Q. System quality is in second place and enjoyment is the third important construct. Information quality came in last place and it is the least important. The effect of 3D on attitude toward website is more than the attitude toward the presented product. They found that attitude toward the presented product and attitude toward the website both have a significant relationship with the user's satisfaction. Virtual product experience moderates the relationship between these three constructs.

Hewawalpita and Perera (2017) focussed on the effect of 3D product presentation on purchase decision, value perception and consumer experience. They made two experiments on mobile and computer screens. In the first experiment they provide normal product view and 360° turnable view with 12 and 24 images of the actual product and in the second experiment horizontal as well as vertical turnable views are provided. They found that the consumer's attitude toward 360° view of 3D products is positive when these are shown on computer screen which leads to pleasure and satisfies the emotional arousal of the customer mind that affects purchase intention. They also found that the perceived value of customers is more when the product is shown in 360° smoother product visualization increase the purchase likelihood. As the mobile users increasing rapidly the main attention should be on them, and try to reduce the loading time to make product visualization smoother.

Wodehouse and Abba (2016) explored different factors that increase interactivity and enjoyment of shopping by using 3D in a shopping catalogue. 3D graphics increase the illusion that creates a sense of presence. Risk perception also reduced by using the 3D product presentation technique. Three major themes of consumer behavior are identified after reviewing the literature; these are "psychology, interface and technology". They describe the interface and identify the three key factors of it namely "interaction, ease of use and experience". They took a sample of 39 participants and framed the "immersive tendency questionnaire (ITQ) and presence questionnaire (PQ)" on a seven-point Likert scale. ITQ is asked to fill out before and PQ after the experiment is done. Pearson correlation uses to

find out related and uncorrelated factors of ITQ and PQ. They find that distraction and information are the major factors of interaction. Hardware helps to reduce distraction and information presented enhance the customer engagement. With the context of realism, some sensory factors like “effective texture, movement and lighting” deliver a better 3d experience. They also find that 3D virtual shopping leads to high stimulus than the 2D product view. Through the literature review, it is also found that “video, colours, music, smell and light” have a favourable effect on the behaviour of the consumer.

Algharabat and Shatnawi (2014) studied the effect of “perceived usefulness, perceived enjoyment and perceived social presence on 3D quality and further the impact of 3D-Q on perceived risk and purchase intention” for apparels. They find that these are good antecedents (PU, PE and PSP) of 3D quality. if 3D is perceived by customers as useful and friendly, then it has a good quality. 3D-Q is also enhanced by product informations which is delivered by 3D presentation like “size and fabric type”. They also find that there is an inverse relationship between “3D and perceived psychological risk”. 3D also facilitates information transmission like “facial expression, posture, dress and non-verbal cues” that stimulate a “sense of human warmth and socialability”.

Choi and Taylor (2014) studied the impact of 3D advertisement in the virtual environment and they examined the effect of “vividness of mental imagery as mediator and product type and need for touch as a moderator.” They took a watch as a geometric product and jacket as a material product for the study. It is found that 3D advertisement has a more significant effect than the 2D advertisement to enhance the “Consumer’s attitude toward the brand, purchase intention and intention to revisit the website”. They also found that the effect of 3D advertising is superior to geometric products than on material products.

Algharabat (2014) studied the impact of “visual control and graphical characteristics on perceive trust”. He took a sample of 140 respondents in his study. He studied that how these two antecedents individually and jointly affect the perceived trust. He found that the perceived trust of customers is enhanced by presenting products with high “visual control and graphical characteristics” and the interaction effect of these two antecedents on perceived trust is significant. They also found that the graphical characteristic has no significant impact on perceived trust if the visual control is low and the effect of visual higher than the visual control.

Raed S. Algharabat and ElSamen (2013) studied the influence of “3D product presentation on trust, attitude and enjoyment” in jewelry industries. Further, they studied the influence of these attributes on purchase intention. A proposed research model is presented in their study with seven variables namely “vividness, interactivity, 3D product presentation, attitude toward the presented products, enjoyment, trust and purchase intention”. They created a hypothetical retail website with 3D product presentation, where the participants can rotate, zoom in or out the product. They took a sample of 380 respondents between the age group of 25-40. They found that “attitude, enjoyment and trust” worked as a mediator between the purchase intention and 3D product presentation. Interactivity and vividness have a favorable relationship with 3D product presentation and product presentation is positively related to “trust, attitude and enjoyment” that further positively affect the purchase intention.

In Shim and Lee (2011) highlighted the impact of product presentation (2D and 3D) on the “perceived risk reduction” of customer on apparel features “silhouette, colour, texture and fit”. He

treated “trust and consumer’s actual body size” as a moderating variable. Experimental research design is used by presenting products in 2D images and 3D virtual models with different body shapes. The main finding of his study is that the perceived risk is reduced by the 3D virtual model more than the 2D images. According to him, the 3D model provides more fit information to customers that leads them to go for the right purchase decision.

Edwards and Gangadharbatla (2001) studied the impact of novelty on positive outcomes, when product is presented by 3D technology in e-commerce. They took a sample of 138 students and provides an exposure to 3D and virtual reality. “Novelty and level of information” were manipulated by 3D product presentation with no information or some product attribute information. “Attitude toward the product, purchase intention, attitude toward website with 3D product and future intention to view 3D products” were the dependent variables. It is found that novelty has no effect on attitude formation but it has a significant effect on purchase intention. The novelty effect is also significant for attitude toward website when 3D presentation is not novel and presented with product information only. Consumers will like to see 3D products in the future also and novelty may not create hurdles for companies. This will benefit both customers and companies.

5. Discussion

This paper is a review article that draws its results from earlier empirical studies. Literature supported that novelty of 3D doesn’t create any hurdle for consumers. Even 3D provides more fit-related information that reduces customers’ perceived risk. Overall the review showed that a few features like 3D quality, interactivity, vividness, controllability, usefulness, lead to favorable outcomes like more perceived enjoyment, trust, elicit more mental imagery, attitude, positive word of mouth, sense of presence, purchase intention, repurchase intention and customers’ satisfaction. Immersive technologies, like 3D effect the consumer behavior more than 2D technology does (Ambika *et al.*, 2023). Vividness and immersion were primarily used as predecessors in 3D research since 3D is associated with improving the object’s image by strengthening the illusory sense (Ambika *et al.*, 2023). According to some researchers, these new technologies like 3D influence mental imagery and effectively communicate product messages.

In a study Algharabat *et al.* (2017) mentioned that the e-tailers should present product in such a manner that customer interacts with these as real one which helps to create a significant relationship with “attitude toward website as well as attitude toward the presented product provides the user with positive evaluation for both the online retailers website and the presented product which use 3D technology”. If the quality of 3D product presentation is good it increases virtual product experiences, interactivity and vividness that enhance the overall experiences of users (Algharabat *et al.*, 2017). Experiences and visual presentation affect the sensory cues of customer’s that leads to “customer satisfaction, brand loyalty, product evaluation, purchase intention and willingness to pay” (Yoganathan *et al.*, 2019).

A study conducted by Algharabat and Shatnawi (2014) revealed that high quality of 3D model creates enjoyment and sense of social presence in customer and help them to find out proper information regarding the product. High quality leads to reduce psychological risk and has significant effect on

purchase intention. There are two types of risk perceived by consumers namely “inherent risk and handled risk”. Inherent risk is product specific and the handled risk is the outcome of a process that is used to reduce inherent risk. The literature reviewed by the researcher is showing that risk is reduced by improving the information required. Risk for apparel products can be reduced by different features like “silhouette, fabric colour, fabric texture and fit”. 3D virtual model provides information to consumers, they can zoom in, rotate it and can change the colour of products (In Shim & Lee, 2011). Both 3D product presentation quality and website quality affect the perception of consumers toward e-shopping (R. Algharabat *et al.*, 2017). 3D images create illusionary direct product experience that shape customer’s perception positively (Choi & Taylor, 2014). 3D virtual catalogue would be helpful for both customers and users alike (Wodehouse & Abba, 2016). 3D presentation benefits both advertiser and consumers and provide a “unique form of information” to customers to make a wise purchase decision (Edwards & Gangadharbatla, 2001). Ease of use, interactivity and realism influence consumer behaviour (Wodehouse & Abba, 2016).

Now a day, metaverse related technologies are used in libraries, 3D is one of them. In US libraries mostly 3D technology in the form of printing and model building is used (Guo *et al.*, 2023). Along with AR and VR, 3D is used in tourism and hospitality and game industries. 3D and computer-generated imagery (CGI) are frequently utilized in ads, particularly in the cosmetics sector and this trend is expected to keep evolving in the upcoming year. Online retailers are combining 3D technology along with other metaverse technologies (AR and VR) to induce more interactive virtual product experience. Researchers may anticipate increasingly demanding and engaging buying experiences that conflate the real and electronic realms as Metaverse develops. The Metaverse will certainly have a significant impact on how retail grows in coming years, even though the full extent of its implications in retailing remains to be investigated. The metaverse connects the physical and digital worlds and has the power to transform established standards of management in numerous of disciplines and sectors (Mohanty *et al.*, 2022).

6. Conclusion

The role of 3D technology in e-tailing is irrefutable. The digital retail sector is changing because of 3D technology. E-tailers are attempting to reduce the discrepancy between a good’s actual looks and its virtual representation. Developments in technology, like 3D imagery, has made this task easier. Different theories associated with technologies help to measure the factors that lure customers towards it. 3D has an immense effect on customer attitudes and buying behavior because of its ability to improve product display, interactivity, and vividness and to reduce customers’ perceived risk. Online retailers who make this cutting-edge technological investment are likely to experience faster business growth and a competitive advantage over their rivals. Retailers must adapt to the rapid changes in technology and take advantage of the benefits that 3D technology offers. In addition to producing innovative designs, the use of 3D technology also has concern towards sustainability. The current research outcomes were based on secondary data (only literature review). Researchers may conduct empirical study by adopting different theories along with different product categories to validate the current research outcome.

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